ABC Batteries, Solar Power, Generators, etc.

12 V batteries auto and deep cycle batteries. Deep cycle batteries are designed for 12 V operation up to 80% of discharge before failure. Auto batteries would be severely damaged if they were allowed to drain to 20% of their capacity. Whereas auto batteries are designed for high load cranking power over a short period of time, deep cycle batteries are designed for moderate discharge over a longer period of time. The most common 12 V batteries are lead acid. They come in flooded, AGM, Gel Cell, and other.

Flooded 12v lead acid batteries are the least expensive, not sealed, will out gas, will leak if tipped on its side, and might require liquid refilling. The best way to measure their health is with a hygrometer. One can also measure the voltage.

Standing voltage for 12V lead acid batteries is 12.6V. Charging voltage should be at the least 2 volts above that or 14.6 volts plus.
To test a 12 V battery, place a load on it. Take a 50 watt 12 v light bulb (like an incandescent headlamp from an auto store) and switch it on while measuring the voltage. If that battery is shot the voltage will sag quickly to 12 volts or less.

The best 12v batteries recommended for radio usage are the deep cycle Absorbent Glass Mat (AGM) batteries. They don't spill, outgas while charging, or require any maintenance except charging. Marine, wheel chair, and golf cart batteries are also good. Gel cells do not spill, but may not last as long as AGM batteries, as they can get overheated more easily.

Although the AGM batteries can be charged faster and can be deeply discharged with full recovery, they can be sensitive to float charging over heating (trickle chargers beware). Charge them like a regular deep cycle battery, but then lower the maintenance charge to no more than 2.25 and 2.30V/cell (13.5 -13.8v)

Here is the skinny from the Battery University:

"AGM has very low internal resistance, is capable to deliver high currents on demand and offers a relatively long service life, even when deep cycled. AGM is maintenance free, provides good electrical reliability and is lighter than the flooded lead acid type. While regular lead acid batteries need a topping charge every six months to prevent the buildup of sulfation, AGM batteries are less prone to sulfation and can sit in storage for longer before a charge becomes necessary. The battery stands up well to low temperatures and has a low self-discharge.

The leading advantages of AGM are a charge that is up to five times faster than the flooded version, and the ability to deep cycle. AGM offers a depth-of-discharge of 80 percent; the flooded, on the other hand, is specified at 50 percent DoD to attain the same cycle life. The negatives are slightly lower specific energy and higher manufacturing costs than the flooded, but cheaper than the gel battery.

Most AGM batteries are mid-sized and range from 30 to 100Ah. They can also be found in UPS, big and small for stationary and deep cycle use. They are commonly built to size and are found in high-end vehicles to run power-hungry accessories such as heated seats, steering wheels, mirrors and windshields. NASCAR and other auto racing leagues choose AGM products because they are vibration resistant.

AGM is the preferred battery for upscale motorcycles. Being sealed, AGM reduces acid spilling in an accident, lowers the weight for the same performance and allows installation at odd angles. Because of good performance at cold temperatures, AGM batteries are also used for marine, motor home and robotic applications.

AGM is making inroads into the start-stop function of cars. The classic flooded type is simply not robust enough and repeated cycling causes a sharp capacity fade after only two years of use.

REDUCE FLOAT CHARGE

As with all gelled and sealed units, AGM batteries are sensitive to overcharging. A charge to 2.40V/cell (and higher) is fine; however, the float charge should be reduced to between 2.25 and 2.30V/cell (summer temperatures may require lower voltages). Automotive charging systems for flooded lead acid often have a fixed float voltage setting of 14.40V (2.40V/cell); a direct replacement with a sealed unit could overcharge the battery on a long drive."

When charging 12 v batteries, one will notice that a voltmeter will read 13.6 volts or higher; but when the charge is removed it will settle to 12.6 Vdc in a matter of 5 minutes. Float Charge AGMs no more than at 13.8 Volts; rapid charge at 14.5 volts.

AGM and other sealed batteries do not like heat and should be installed away from the engine compartment.

The price of **Lithium-Iron 12V batteries** are becoming less expensive. Their advantage is their light weight and longevity. Portable Operations

Lead acid batteries are relatively inexpensive, but the trade-off is weight, capacity, self-discharge and overall life; Only sealed lead acid (SLA) batteries should be used to prevent spillage

LiFePO4 batteries are less than half the weight of an equivalent SLA battery, has more useable capacity, can sit for long periods of time without losing much charge and has 4 times the life. The trade-off is price, but in the long-term they pay for themselves

Home / Base Operations

Weight is less of an issue so lead acid batteries have fewer disadvantages. Never use flooded batteries inside the house due to out-gassing. Need to keep them on a float charge when not in use

LiFePO4 batteries will have a much longer life and will be easier
to move around, but are expensive, especially for occasional use

Understanding Amp hours (AH) and Milliamp hours (MAH)

For our use deep cycle batteries rated in Amp hours (AH) is an indication of its capacity (how many amps that it can produce over a period of hours. 1 amp hour equals a current draw of 1 amp for 1 hour. A 500 ma appliance (1/2 amp) will draw only ½ amp in 1 hour. A 10 amp appliance will draw 10 AH in one hour. A 100 amp draw will draw 100 AHs, etc,.

Lithium Iron (LIFEPO4) Batteries come in high capacity

Pros
Very low self-discharge
Relatively flat discharge curve
Can be recharged thousands of times
Will not leak
No outgassing
High energy density
Unlike Li-Ion, LiFePO4 is very safe
Can be field charged using a lead
acid battery charger
Peukert constant = 1.01 or less

Cons
Expensive
Must balance the cells using a proper
LiFePO4 charger

Alkaline, Nicads, and NiMh Batteries

ALKALINE

Pros
Very low self-discharge (10 year shelf life)
Ubiquitous
Adapters available for most HTs

Cons
Poor high current handling
Single use (non-rechargeable)
Possibility of leakage
Moderate energy density

NICKEL METAL HYDRIDE (NIMH)

Pros
Good for high current applications
Rechargeable
Relatively long shelf life (retains 80% capacity after 1 year)
Will not leak
Adapters available for most HTs

Cons
Moderate energy density
Only 1.2v vs 1.5v of alkalines

LITHIUM ION

Pros
Advantages
Rechargeable
Very lightweight
Able to provide a great deal of energy in a short amount of time
Very low self-discharge
Will not leak
No outgassing
High energy density

CONS

Can explode and cause fire if abused

Charging Nicads (Nickel Cadmium) batteries and Nickel Metal Halide (NiMh)

Can I use an older NiCd battery charger to charge NiMH batteries?

The answer to this question depends on the type of NiCd charger. Many of the older NiCd chargers are the simple timed type charger which will charge batteries for a fixed amount of time and then shut off. Unfortunately, since NiCd batteries have a much lower capacity than NiMH batteries, the timer is likely to shut off long before the NiMH batteries are fully charged. This won't harm the batteries, but the NiMH batteries won't be fully charged since the timer will have stopped the charge cycle too soon.

Also common among older NiCd chargers are the so called "overnight" chargers which charge batteries at a low rate as long as the charger is plugged in. This type of charger can fully charge NiMH batteries, but it might take a very long time to do so. It's possible that an old NiCd charger could take as long as 48 hours to fully charge new high capacity NiMH batteries! This type of charger is not likely to damage NiMH batteries unless the batteries are left in the charger for weeks at a time, but it may not be very convenient to use. If you have this type of charger you can get an idea of how long you'll need to charge your batteries by using the calculator found above.

The final possibility is that the older NiCd charger is a rapid charger that will charge NiMH batteries but will not have the necessary circuitry to stop the charge cycle once the NiMH batteries are fully charged. If the NiCd charger is designed to charge batteries in less than two hours it may be this type. In this case the risk is that the older charger will overcharge NiMH batteries. This will be apparent if the batteries get very hot during the charge cycle. (It is normal for NiMH batteries to get warm as they become fully charged, especially in a rapid charger). If the NiMH batteries get too hot to handle and stay that way for more than 20 or 30 minutes, then the NiCd charger is most likely overcharging the NiMH batteries and may shorten their life. You would be most likely to encounter this type of charger if the charger was designed for rapid charging radio control (RC) vehicle batteries. We would recommend that you not use an NiCD rapid charger to charge NiMH batteries.

Which are better, NiCD or NiMH batteries?

NiCDs are heavier, more toxic, suffer from a memory effect and have less capacity at the same size as NiMH batteries.

What is battery conditioning or exercising? Memory effect in NiCDs

When you intentionally discharge a battery down to a certain minimum voltage and then recharge it this is known as battery conditioning or reconditioning . It is also sometimes referred to as battery exercise. This is particularly important to reduce what some call the memory effect experienced using NiCD batteries if you habitually do not fully discharge them each time you use them. For NiCD batteries this must be done periodically, approximately every 10 charge/discharge cycles or so, or the batteries will begin to lose capacity.

For NiMH batteries conditioning is not really needed to reduce any memory effect because that is negligible in this type of battery. However, reconditioning is very convenient for both NiMH and NiCD batteries because **brand new batteries** are not charged when you receive them and they must be charged and discharged three to five times before they reach their full capacity. In addition, occasionally conditioning rechargeable batteries helps to ensure that they give you years or service and save you as much money as possible, before you recycle them and get new ones.

CONCLUSION

Use the highest capacity Li-Ion battery available for your radio
When using the AA adapter
Alkaline batteries are the worst choice. Use as the last resort
Energizer Ultimate Lithium batteries are the best choice for single-use batteries
Extremely low self-discharge (95% of capacity after 20 years)
Handles high current discharge
About $1.50 per battery

Panasonic Eneloop batteries are the best choice for rechargeable batteries
Relatively low self-discharge (85% of charge after 1 year)
Can be recharged up to 2100 times
Handles high current discharge
About $2.00 per battery
Never charge from the radio

SMALL BATTERY CHARGERS

Maha PowerEx MH-C808M
Can charge any combination of 8 AAA, AA, C, D (MaHa MH-C801D or MH-C800S if you only want to charge AA and AAA)
Fast and slow charge mode
Requires 120vac

NiteCore D4
Can charge any combination of 4 AA, AAA, AAAA, C, 26650, 22650, 18650, 17670, 18490, 17500, 18350, 16340, 14500, 10440
Can charge from either 120vac or 12vdc (adapter included)

Xtar Dragon VP4
Can charge any combination of 4 AAAA, AAA, AA, A, SC, C, D, 10440, 14500, 14650, 16340, 17335, 17500, 17670, 18350, 18490, 18500, 18650, 22650, 2550, 26650, 32650

0.5a to 2.0a charging modes
Can charge from either 120vac or 12vdc (adapter included)

References:

http://batteryuniversity.com/

Thanks to Rachel Kinoshita, KK6DAC for much of the data
https://drive.google.com/file/d/1QxcEfnqVUQGy-W3rstxNckpiozATY1AB/view

This document https://drive.google.com/open?id=1jl4U47NjdXTlaPnbiu402CDB6Xu4AyCs